

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING
SECTION 23 36 00 – AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Base Bid

1. Ventilating Contractor
 - a. Shutoff, single-duct air terminal units.
 - b. Series, fan-powered air terminal units.

1.2 SUBMITTALS

A. Product Data: For each type of air terminal unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For air terminal units.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.

D. CLOSEOUT SUBMITTALS

1. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
 - a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1) Instructions for resetting minimum and maximum air volumes.
 - 2) Instructions for adjusting software set points.

E. MAINTENANCE MATERIAL SUBMITTALS

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Fan-Powered-Unit Filters: Furnish one spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- B. Casing: **0.040-inch** thick galvanized steel, single wall.
 1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass or flexible elastomeric duct liner.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from **zero to 140 deg F**, shall be impervious to moisture and fungus, shall be suitable for **10-inch wg** static pressure, and shall be factory tested for leaks.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 1. Maximum Damper Leakage: AHRI 880 rated, **2** percent of nominal airflow at **6-inch wg** inlet static pressure.
 2. Damper Position: Normally open.
- E. Attenuator Section: **0.034-inch** steel sheet.

1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass or flexible elastomeric duct liner.
 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- F. Control devices shall be compatible with the base building temperature controls system.
1. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit.
 2. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
 - a. Occupied and unoccupied operating mode.
 - b. Remote reset of airflow or temperature set points.
 - c. Adjusting and monitoring with portable terminal.
 3. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.
- G. Control Sequences:
1. Occupied:
 - a. In a call for cooling, airflow will increase as the damper opens towards maximum setting to satisfy set point.
 - b. In a call for less cooling, airflow will decrease as the damper closes towards minimum setting to satisfy set point.
 2. Unoccupied:
 - a. Damper closes to minimum maximum setting.

2.3 SERIES FAN-POWERED AIR TERMINAL UNITS

- A. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud for installation above a ceiling.
1. Designed for quiet operation.
 2. Low-profile design.
- B. Casing: **0.040-inch** thick galvanized steel, single wall.
1. Casing Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass or flexible elastomeric duct liner.
 2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
 5. Fan: Forward-curved centrifugal.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at **3-inch wg** inlet static pressure.
 2. Damper Position: Normally open.
- D. Velocity Sensors: Multipoint array with velocity sensors in air inlets and air outlets.
- E. Motor:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Type: Electronically commutated motor.
 3. Fan-Motor Assembly Isolation: Rubber isolators.
 4. Enclosure: Open dripproof, Totally enclosed, fan cooled
 5. Efficiency: Premium efficient.
 6. Motor Speed:
 - a. Speed Control: Infinitely adjustable with pneumatic-electric and electronic controls.
 7. Electrical Characteristics:
 - a. Horsepower: See Schedule on plans
 - b. Volts: See Schedule on plans
 - c. Phase: See Schedule on plans
 - d. Hertz: 60.
- F. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Material: Polyurethane foam having 70 percent arrestance and 3 MERV.
 2. Material: Glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.
 3. Material: Pleated cotton-polyester media having 90 percent arrestance and 7 MERV.
 4. Thickness: **1 inch**
- G. Attenuator Section: **0.034-inch** galvanized steel.
1. Attenuator Section Liner: Comply with requirements in "Casing Liner" Article for fibrous-glass or flexible elastomeric duct liner.
 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and

secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. SCR controlled.
 2. Access door interlocked disconnect switch.
 3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
 4. Nickel chrome 80/20 heating elements.
 5. Airflow switch for proof of airflow.
 6. Fan interlock contacts.
 7. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 8. Mercury contactors.
 9. Pneumatic-electric switches and relays.
 10. Magnetic contactor for each step of control (for three-phase coils).
- I. Factory-Mounted and -Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.
 2. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.
 3. Disconnect Switch: Factory-mounted, fuse type.
- J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- K. Control devices shall be compatible with existing base building temperature controls system.
1. Electric Damper Actuator: 24 V, powered open, spring return.
 2. Electronic Damper Actuator: 24 V, powered open, [**spring**] [**capacitous**] return.
 3. Electric Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit, and space temperature set point.
 4. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit.
 5. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to **4-inch wg**; and shall have a multipoint velocity sensor at air inlet.
 6. Terminal Unit Controller: Pressure-independent, VAV controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
- L. Control Sequence:
1. Occupied (Primary Airflow On):
 - a. Operate as throttling control for cooling.
 - b. As cooling requirement decreases, control valve throttles toward minimum airflow.

- c. As heating requirement increases, fan energizes to draw in warm plenum air and electric heat is energized in steps.
- 2. Unoccupied (Primary Airflow Off):
 - a. When externally initiated, begin the morning warm-up/cool-down function. Damper drives to the fully open position without regard for the preset maximum.
 - b. When pressure at primary inlet is zero or less, fan is de-energized.
 - c. As heating requirement increases, fan energizes to draw in warm plenum air and electric heat is energized in steps.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to AHRI 880.
 - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows and AHRI certification seal.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.2 TERMINAL UNIT INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.3 CONNECTIONS

- A. Comply with requirements in Section 233113 "Metal Ducts" for connecting ducts to air terminal units.
- B. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Startup service is to include the following:
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.

6. Verify that controls respond to inputs as specified.

END OF SECTION 233600